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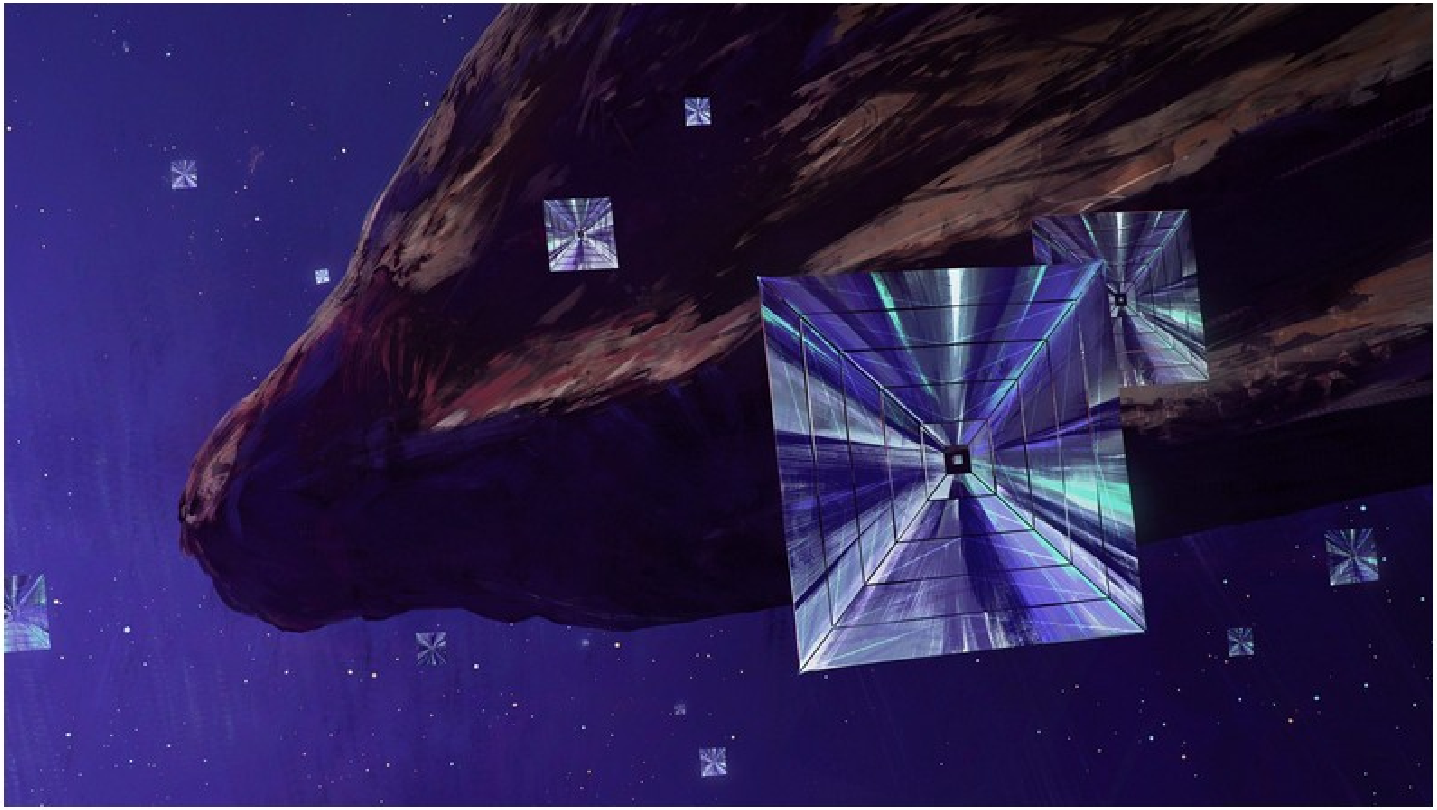
Project Lyra – A Mission to 'Oumuamua

Project Lyra develops concepts for reaching the interstellar asteroid 'Oumuamua with a spacecraft, based on near-term technologies. But what is an interstellar asteroid?



arXiv:1711.03155

Project Lyra: Sending a Spacecraft to 1I/'Oumuamua (former A/2017 U1), the Interstellar Asteroid

Andreas M. Hein[1], Nikolaos Perakis[1], T. Marshall Eubanks[1,2], Adam Hibberd[1], Adam Crowl[1], Kieran Hayward[1], Robert G. Kennedy III[1], Richard Osborne[1]

Contact email: andreas.hein@i4is.org

[1] Initiative for Interstellar Studies, Bone Mill, New Street, Charfield, GL12 8ES, United Kingdom

[2] Asteroid Initiatives LLC

Abstract

The first definitely interstellar object 1I/'Oumuamua (previously A/2017 U1) observed in our solar system provides the opportunity to directly study material from other star systems. Can such objects be intercepted? The challenge of reaching the object within a reasonable timeframe is formidable due to its high heliocentric hyperbolic excess velocity of about 26 km/s; much faster than any vehicle yet launched. This paper presents a high-level analysis of potential near-term options for a mission to 1I/'Oumuamua and potential similar objects. Launching a spacecraft to 1I/'Oumuamua in a reasonable timeframe of 5-10 years requires a hyperbolic solar system excess velocity between 33 to 76 km/s for mission durations between 30 to 5 years. Different mission durations and their velocity requirements are explored with respect to the launch date, assuming direct impulsive transfer to the intercept trajectory. For missions using a powered Jupiter flyby combined with a solar Oberth maneuver using solid rocket boosters and Parker Solar Probe heatshield technology, a Falcon Heavy-class launcher would be able to launch a spacecraft of dozens of kilograms towards 1I/'Oumuamua, if launched in 2021. An additional Saturn flyby would allow for the launch of a New Horizons-class spacecraft. Further technology options are outlined, ranging from electric propulsion, and more advanced options such as laser electric propulsion, and solar and laser sails. To maximize science return decelerating the spacecraft at 'Oumuamua is highly desirable, due to the minimal science return from a hyper-velocity encounter. Electric and magnetic sails could be used for this purpose. It is concluded that although reaching the object is challenging, there seem to be feasible options based on current and near-term technology.

arXiv:1902.04935

Project Lyra: Catching 1I/‘Oumuamua – Mission Opportunities After 2024

Adam Hibberd[1], Andreas M. Hein[1], T. Marshall Eubanks[1,2]

[1] Initiative for Interstellar Studies (i4is)

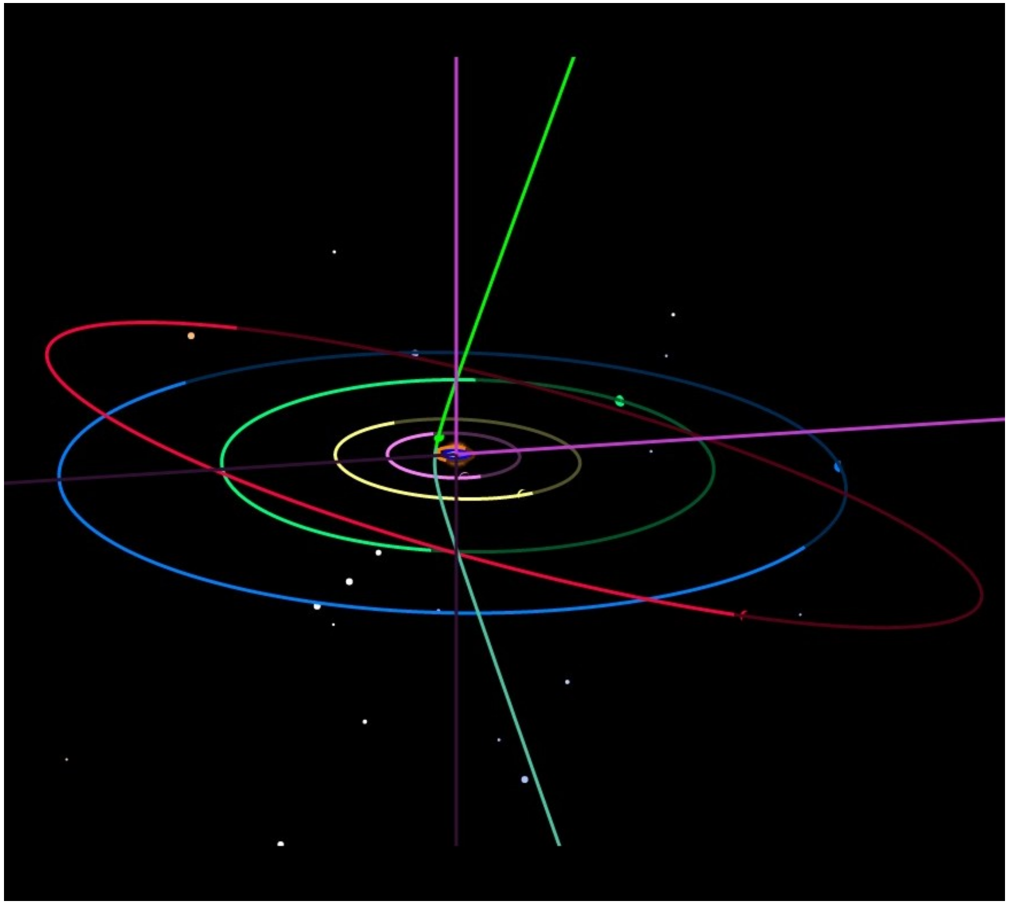
Bone Mill, New Street, Charfield, GL12 8ES, United Kingdom

[2] Space Initiatives Inc., USA

Abstract

In October 2017, the first interstellar object within our solar system was discovered. Today designated 1I/’Oumuamua, it shows characteristics that have never before been observed in a celestial body. Due to these characteristics, an in-situ investigation of 1I would be of extraordinary scientific value. Previous studies have demonstrated that a mission to 1I/’Oumuamua is feasible using current and near-term technologies however with an anticipated launch date of 2020-2021, this is too soon to be realistic. This paper aims at addressing the question of the feasibility of a mission to 1I/’Oumuamua in 2024 and beyond. Using the OITS trajectory simulation tool, various scenarios are analyzed, including a powered Jupiter flyby and Solar Oberth maneuver, a Jupiter powered flyby, and more complex flyby schemes including a Mars and Venus flyby. With a powered Jupiter flyby and Solar Oberth maneuver, we identify a trajectory to 1I/‘Oumuamua with a launch date in 2033, a total velocity increment of 18.2 km/s, and arrival at 1I/’Oumuamua in 2048. With an additional deep space maneuver before the powered Jupiter flyby, a trajectory with a launch date in 2030, a total velocity increment of 15.3 km/s, and an arrival at 1I/’Oumuamua in 2052 were identified. Both launch dates would provide over a decade for spacecraft development, in contrast to the previously identified 2020-2021 launch dates. Furthermore, the distance from the Sun at the Oberth burn is at 5 Solar radii. This results in heat flux values, which are of the same order of magnitude as for the Parker Solar Probe. We conclude that a mission to 1I/’Oumuamua is feasible, using existing and near-term technologies and there is sufficient time for developing such a mission.

Первая настоящая межзвездная комета: 2I/Borisov (gb00234)



Геннадий Борисов (ГАИШ, инженер), Крым, пос. Научный,
65 см телескоп собственной конструкции, 30 августа 2019 г.
В момент открытия ~ 3 а.е. от Солнца
Перигелий 10 декабря 2019, 1.94 а.е. от Солнца
Скорость на бесконечности 30 км/сек
Размер ядра ~2-20 км (комета Галлея ~15 км).

Межзвездные кометы - возможные переносчики спор жизни по Галактике

В лаборатории ожили бактерии возрастом до восьми миллионов лет

Добавить в «Мою Ленту»

Растопив образцы антарктического льда возрастом от ста тысяч до восьми миллионов лет, ученые из университета Ратгерса (США) исследовали обнаруженные там микроорганизмы. Слабые признаки жизни подавали даже бактерии из древнейших образцов, сообщает National Geographic News со ссылкой на соответствующую статью в Proceedings of the National Academy of Sciences.

Штамм 2-9-3

nature
International journal of science

Letter | Published: 19 October 2000

Isolation of a 250 million-year-old halotolerant bacterium from a primary salt crystal

Russell H. Vreeland, William D. Rosenzweig & Dennis W. Powers

Nature **407**, 897–900 (2000) | Download Citation

Here we report the isolation and growth of a previously unrecognized spore-forming bacterium (*Bacillus* species, designated 2-9-3) from a brine inclusion within a 250 million-year-old salt crystal from the Permian Salado Formation. Complete gene sequences of the 16S ribosomal DNA show that the organism is part of the lineage of *Bacillus marismortui* and *Virgibacillus pantothenticus*. Delicate crystal structures and sedimentary features indicate the salt has not recrystallized since formation.

arXiv:1908.00490

THE "TERRASCOPE": ON THE POSSIBILITY OF USING THE EARTH AS AN ATMOSPHERIC LENS

David Kipping[1]

[1] *Department of Astronomy, Columbia University, 550 W 120th Street, New York, NY 10027, USA*

(Received April 5, 2019; Revised July 12, 2019; Accepted July 18, 2019)

Submitted to PASP

ABSTRACT

Distant starlight passing through the Earth's atmosphere is refracted by an angle of just over one degree near the surface. This focuses light onto a focal line starting at an inner (and chromatic) boundary out to infinity, offering an opportunity for pronounced lensing. It is shown here that the focal line commences at ∼85% of the Earth-Moon separation, and thus placing an orbiting detector between here and one Hill radius could exploit this refractive lens. Analytic estimates are derived for a source directly behind the Earth (i.e. on-axis) showing that starlight is lensed into a thin circular ring of thickness WH_{Δ}/R, yielding an amplification of $8H_{\Delta}/W$, where H_{Δ} is the Earth's refractive scale height, R is its geopotential radius, and W is the detector diameter. These estimates are verified through numerical ray-tracing experiments from optical to 30 µm light with standard atmospheric models. The numerical experiments are extended to include extinction from both a clear atmosphere and one with clouds. It is found that a detector at one Hill radius is least affected by extinction since lensed rays travel no deeper than 13.7 km, within the statosphere and above most clouds. Including extinction, a 1 metre Hill radius "terrascope" is calculated to produce an amplification of ∼45,000 for a lensing timescale of ∼20 hours. In practice, the amplification is likely halved in order to avoid daylight scattering i.e. 22,500 (Δmag=10.9) for W =1 m, or equivalent to a 150 m optical/infrared telescope.

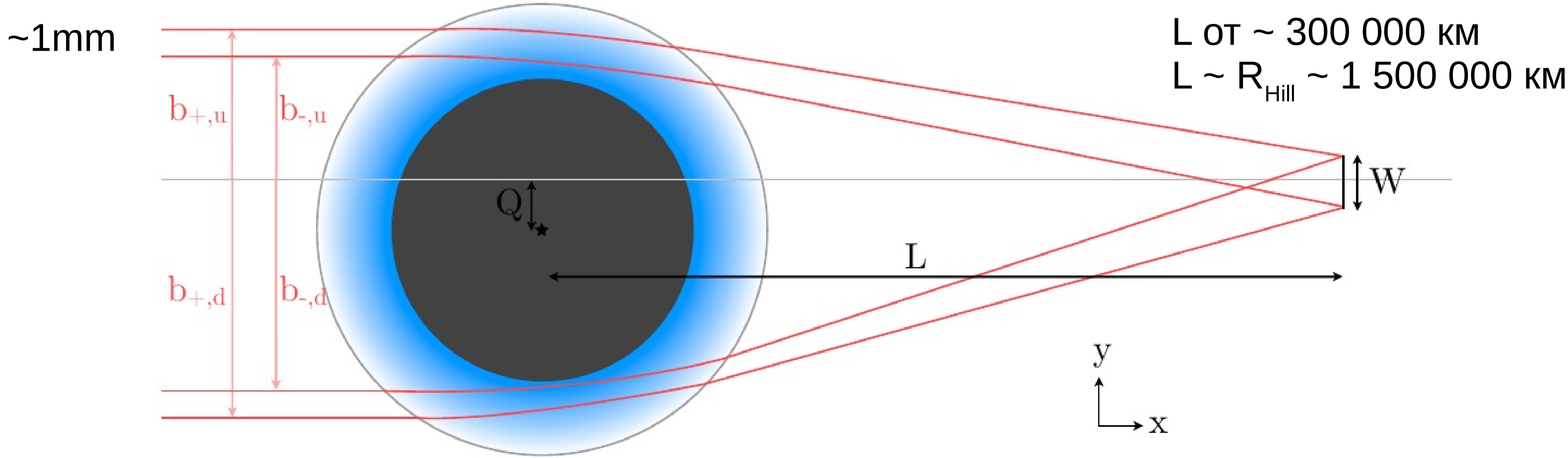
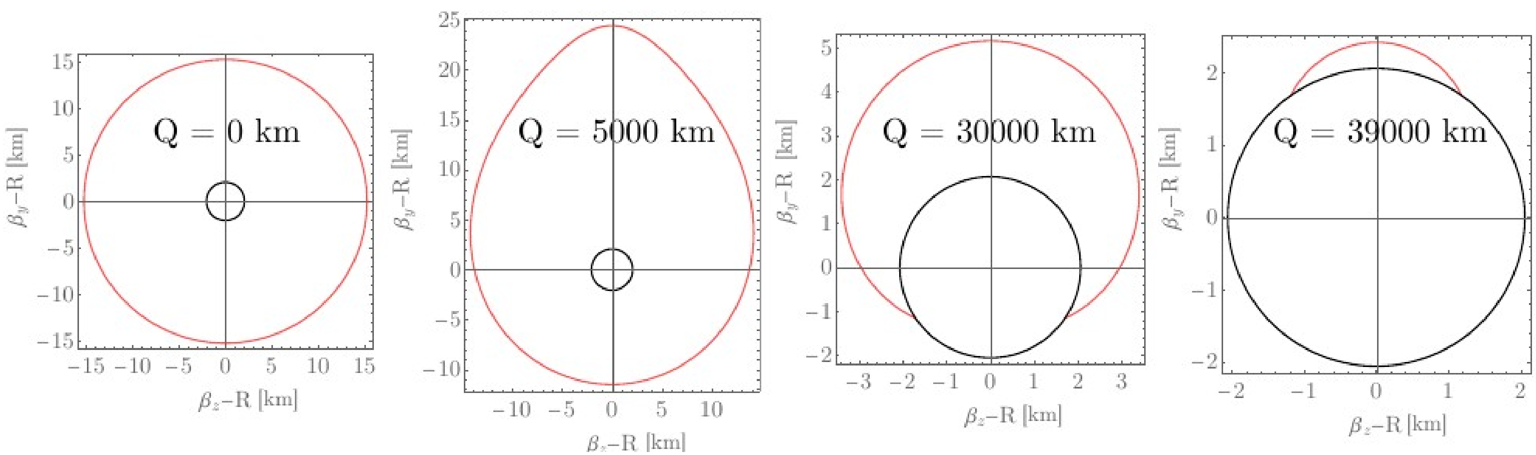


Figure 7. Same as Figure 5 except for off-axis lensing. Only the extrema rays in the $z = 0$ plane are shown.



$$\text{Усиление: } \mathcal{A} = \varepsilon \frac{55000}{W/1m}; \quad \text{Эффективная апертура: } \frac{W_{eff}}{1m} = 235\sqrt{\varepsilon}\sqrt{\frac{W}{1m}}$$

Точечный источник наблюдается непрерывно ~20 часов (R_{Hill}).

Турбулентность: Изменение формы, но не толщины «изображения»

arXiv:1906.07391

THE BREAKTHROUGH LISTEN SEARCH FOR INTELLIGENT LIFE: PUBLIC DATA, FORMATS, REDUCTION AND ARCHIVING

Matthew Lebofsky,[1] Steve Croft,[1] Andrew P. V. Siemion,[1,2,3,4] Danny C. Price,[1,5] J. Emilio Enriquez,[1,3] Howard Isaacson,[1,6] David H. E. MacMahon,[1] David Anderson,[7] Bryan Brzycki,[1] Jeff Cobb,[7] Daniel Czech,[1] David DeBoer,[1] Julia DeMarines,[1] Jamie Drew,[8] Griffin Foster,[1,9] Vishal Gajjar,[1] Nectaria Gizani,[1,10] Greg Hellbourg,[11] Eric J. Korpela,[7] Brian Lacki,[12] Sofia Sheikh,[13] Dan Werthimer,[1] Pete Worden,[8] Alex Yu,[14] and Yunfan Gerry Zhang[1]

ABSTRACT

Breakthrough Listen is the most comprehensive and sensitive search for extraterrestrial intelligence (SETI) to date, employing a collection of international observational facilities including both radio and optical telescopes. During the first three years of the *Listen* program, thousands of targets have been observed with the Green Bank Telescope (GBT), Parkes Telescope and Automated Planet Finder. At GBT and Parkes, observations have been performed ranging from 700 MHz to 26 GHz, with raw data volumes averaging over 1 PB / day. A pseudo-real time software spectroscopy suite is used to produce multi-resolution spectrograms amounting to approximately 400 GB h^{-1} GHz^{-1} $beam^{-1}$. For certain targets, raw baseband voltage data is also preserved. Observations with the Automated Planet Finder produce both 2-dimensional and 1-dimensional high resolution ($R \sim 10^5$) echelle spectral data.

Although the primary purpose of *Listen* data acquisition is for SETI, a range of secondary science has also been performed with these data, including studies of fast radio bursts. Other current and potential research topics include spectral line studies, searches for certain kinds of dark matter, probes of interstellar scattering, pulsar searches, radio transient searches and investigations of stellar activity. *Listen* data are also being used in the development of algorithms, including machine learning approaches to modulation scheme classification and outlier detection, that have wide applicability not just for astronomical research but for a broad range of science and engineering.

In this paper, we describe the hardware and software pipeline used for collection, reduction, archival, and public dissemination of *Listen* data. We describe the data formats and tools, and present Breakthrough Listen Data Release 1.0 (BLDR 1.0), a defined set of publicly-available raw and reduced data totalling 1 PB.

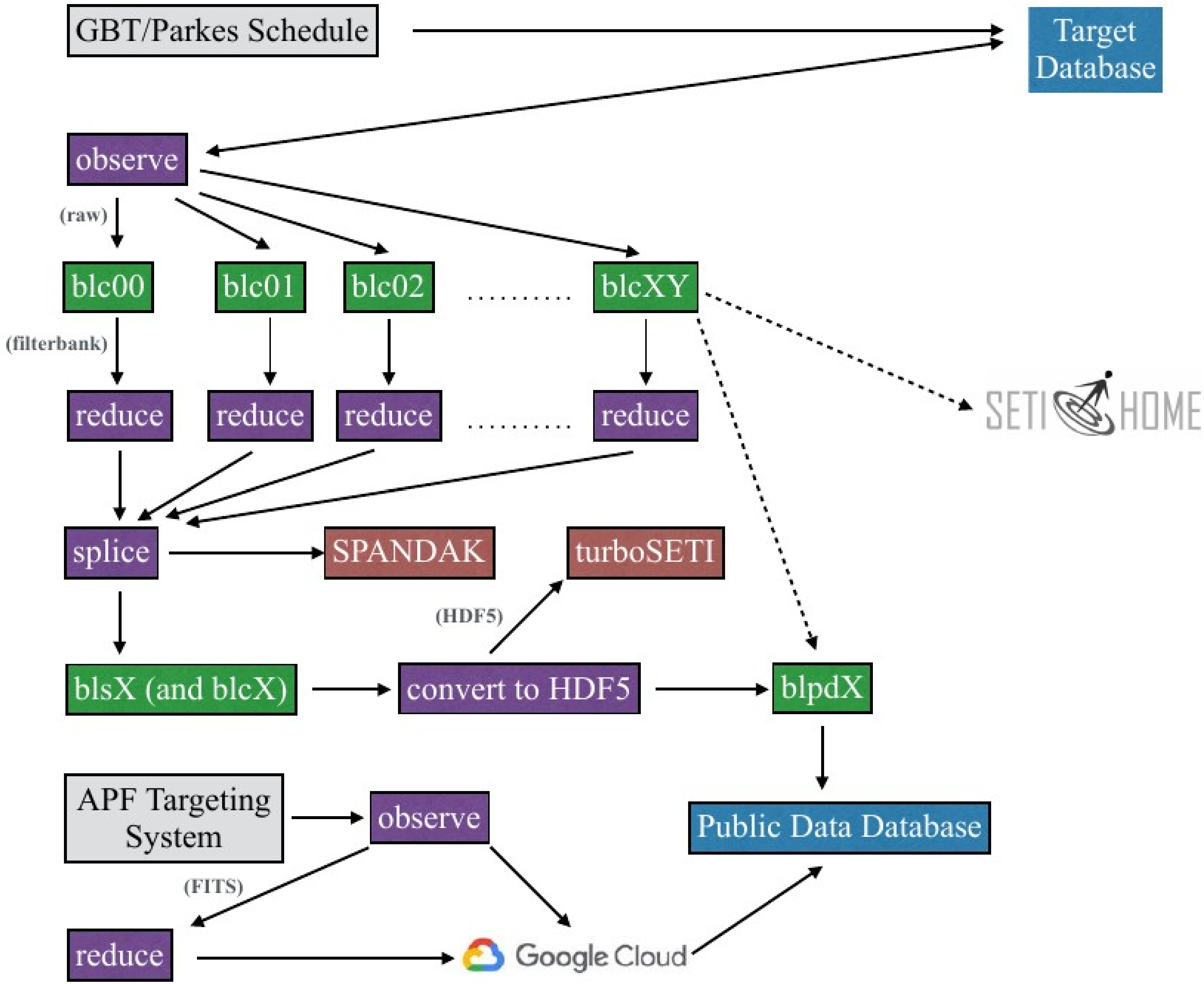
arXiv:1906.077509

The Breakthrough Listen Search for Intelligent Life: Observations of 1327 Nearby Stars over 1.10–3.45 GHz

DANNY C. PRICE,[1,2] J. EMILIO ENRIQUEZ,[1,3] BRYAN BRZYCKI,[1] STEVE CROFT,[1] DANIEL CZECH,[1] DAVID DEBOER,[1] JULIA DEMARINES,[1] GRIFFIN FOSTER,[1,4] VISHAL GAJJAR,[1] NECTARIA GIZANI,[1,5] GREG HELLBOURG,[1] HOWARD ISAACSON,[1,6] BRIAN LACKI,[7] MATT LEBOFSKY,[1] DAVID H. E. MACMAHON,[1] IMKE DE PATER,[1] ANDREW P. V. SIEMION,[1,8,3,9] DAN WERTHIMER,[1] JAMES A. GREEN,[10] JANE F. KACZMAREK,[10] RONALD J. MADDALENA,[11] STACY MADER,[10] JAMIE DREW,[12] AND S. PETE WORDEN[12]

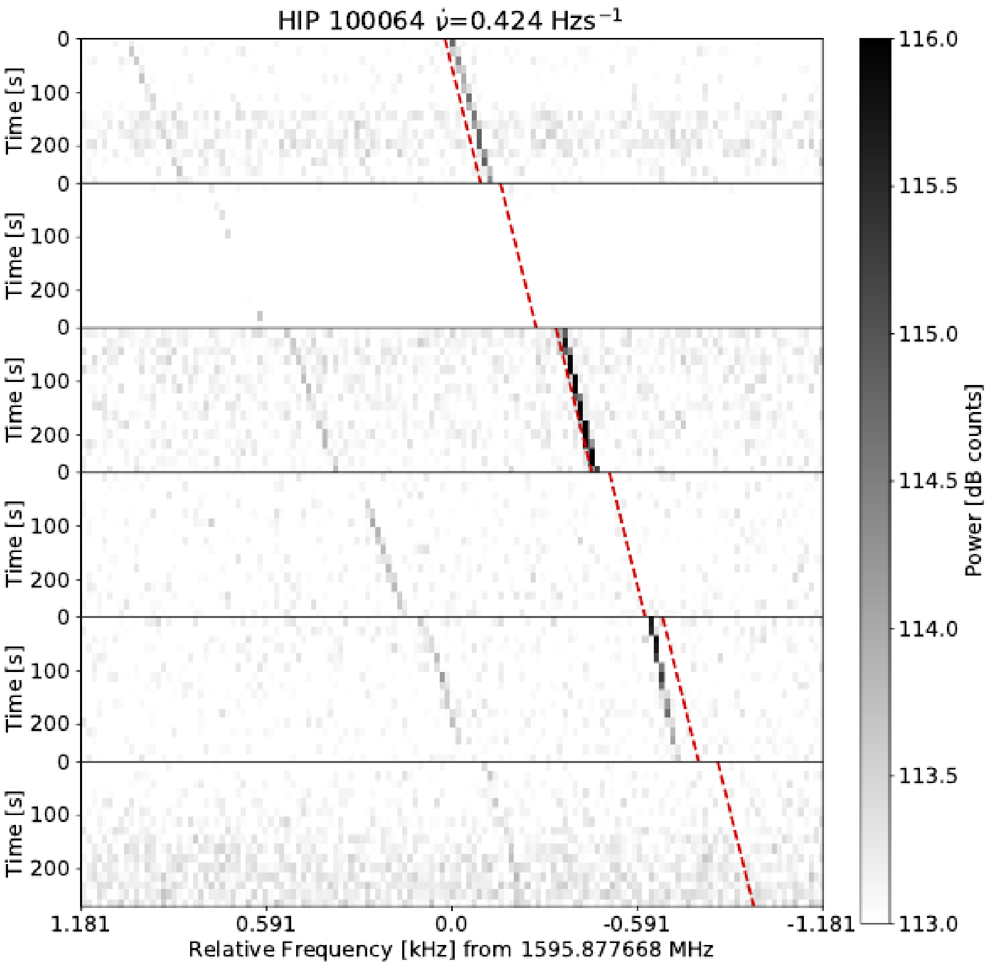
ABSTRACT

Breakthrough Listen (BL) is a ten-year initiative to search for signatures of technologically capable life beyond Earth via radio and optical observations of the local Universe. A core part of the BL program is a comprehensive survey of 1702 nearby stars at radio wavelengths (1–10 GHz). Here, we report on observations with the 64-m CSIRO Parkes radio telescope in New South Wales, Australia, and the 100-m Robert C. Byrd Green Bank radio telescope in West Virginia, USA. Over 2016 January to 2019 March, a sample of 1138 stars was observed at Green Bank using the 1.10–1.90 GHz and 1.80–2.80 GHz receivers, and 189 stars were observed with Parkes over 2.60–3.45 GHz. We searched these data for the presence of engineered signals with Doppler-acceleration drift rates between $\pm 4\,\mathrm{Hz\,s^{-1}}$. Here, we detail our data analysis techniques and provide examples of detected events. After excluding events with characteristics consistent with terrestrial radio interference, we are left with zero candidates. Given the sensitivity of our observations, we can put an upper limit on the power of potential radio transmitters at these frequencies at 2.1×10^{12} W, and 9.1×10^{12} W for GBT and Parkes respectively. These observations constitute the most comprehensive search over 1.10–3.45 GHz for technosignatures to date for Kardashev Type I civilizations. All data products, totalling $\sim$219 TB, are available for download as part of the first BL data release (DR1), as described in a companion paper (Lebofsky et. al., 2019)



Каждый кандидат получает 3 интегрирования по 5 минут с 5-и минутными перерывами (30-и минутный цикл)

Примеры сигналов-кандидатов



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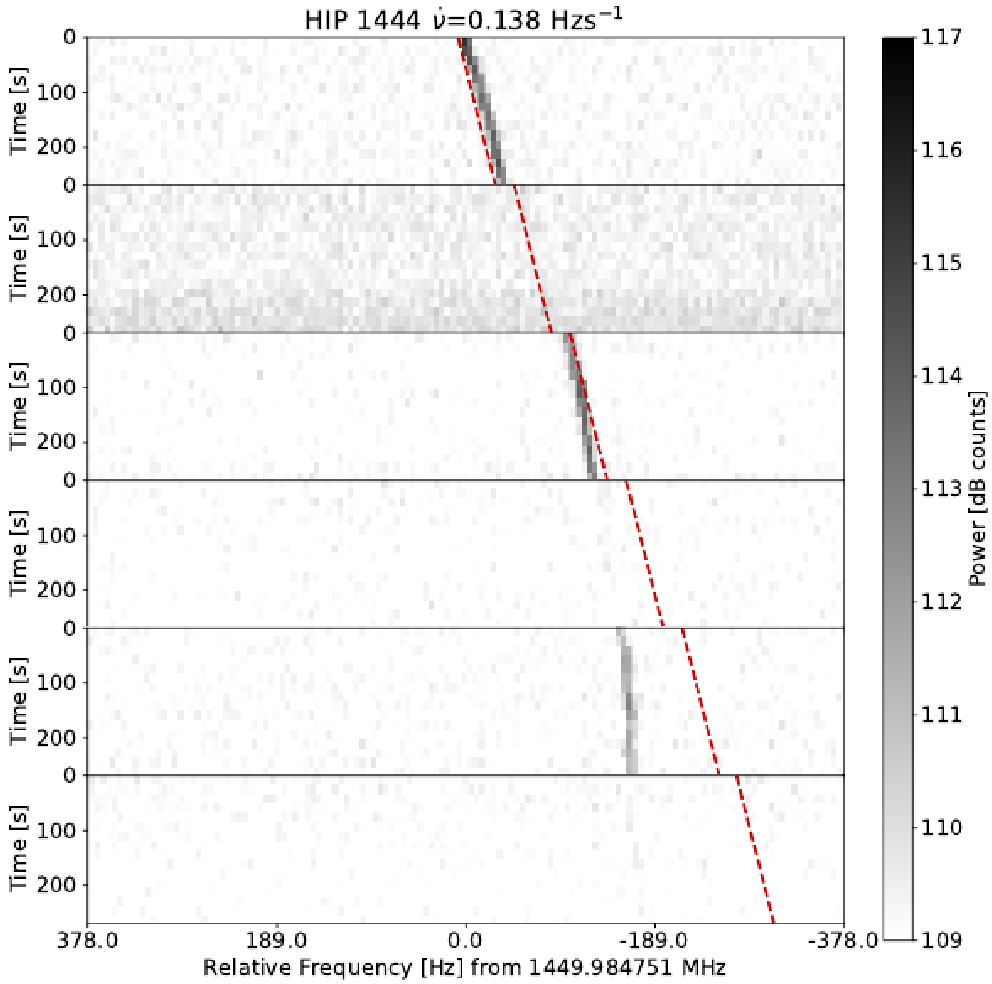

(d) HIP1444

АСТРОФИЗИЧЕСКИЙ БЮЛЛЕТЕНЬ, 2019, том 74, № 2, с. 252–264

УДК 524.82:520.27; 524.88

НАБЛЮДЕНИЯ ПО ПРОГРАММЕ SETI НА ТЕЛЕСКОПЕ РАТАН-600 В 2015 И 2016 ГГ.

© 2019 А. Д. Панов[1*], Н. Н. Бурсов[2], Г. М. Бескин[2,3], А. К. Эркенов[2], Л. Н. Филиппова[4], В. В. Филиппов[4], Л. М. Гиндилис[5], Н. С. Кардашев[6], А. А. Кудряшова[2], Е. С. Стариков[4], Дж. Вилсон[7], Л. А. Пустильник[8]

ISSN 1990-3413, Astrophysical Bulletin, 2019, Vol. 74, No. 2, pp. 234–245. © Pleiades Publishing, Ltd., 2019.
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Observations within the Framework of SETI Program on RATAN-600 Telescope in 2015 and 2016

A. D. Panov[1*], N. N. Bursov[2], G. M. Beskin[2,3], A. K. Erkenov[2], L. N. Filippova[4], V. V. Filippov[4], L. M. Gindilis[5], N. S. Kardashev[6], A. A. Kudryashova[2], E. S. Starikov[4], J. Wilson[7], and L. A. Pustilnik[8]

ARCHAEOLOGY, ANTHROPOLOGY, AND INTERSTELLAR COMMUNICATION

Edited by Douglas A. Vakoch

National Aeronautics and Space Administration
Office of Communications
Public Outreach Division
History Program Office
Washington, DC
2014

The NASA History Series
NASA SP-2013-4413

Library of Congress Cataloging-in-Publication Data

Archaeology, anthropology, and interstellar communication / edited by Douglas A. Vakoch.
p. cm. -- (The NASA history series)
"SP-2013-4413."
1. Life on other planets. 2. Extraterrestrial anthropology. 3. Interstellar communication. 4. Exobiology. 5. Archaeoastronomy. I. Vakoch, Douglas A.
QB54.A74 2012
999--dc23
2011053528

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ISBN 978-1-62683-013-4
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А.М. Хазен. Принцип максимума производства энтропии и движущая сила прогрессивной эволюции жизни и разума. 1993.

В.А. Вагнер. Физиология и биология в решении психологических проблем. 1914.

Проблема SETI и близкие проблемы

Внеземные цивилизации. Труды совещания. Бюракан, 20-23 мая 1964 г. Ереван, 1965.

Внеземные цивилизации. Проблемы межзвездной связи. М.: "Наука", 1969.

Проблема CETI (Связь с внеземными цивилизациями). Бюракан, 5-11 сентября 1971 г. М.: Мир 1971.

Проблема поиска внеземных цивилизаций. М.: Наука, 1981.

Проблема поиска жизни во Вселенной. Труды Таллинского симпозиума. М.: Наука, 1986.

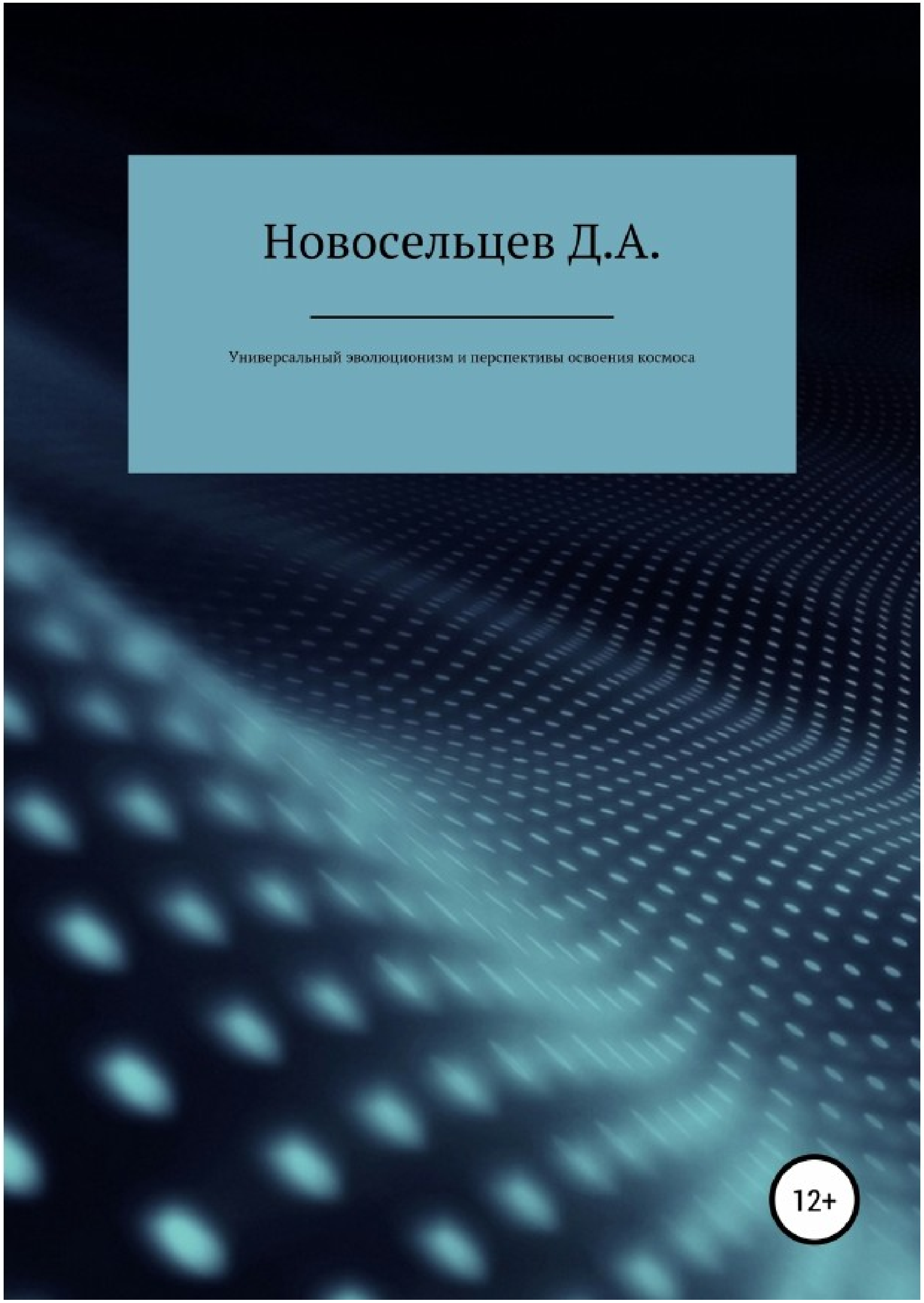
Астрономия и современная картина мира. М.: Российская академия наук, Институт философии, 1996.

Материалы 3-й Международной конференции "Поиск внеземных цивилизаций (SETI-2011)" 27-30 b.yz 2011 г, С.-П. . Труды ИПА РАН. Вып. 22, 2011.

Proceeding of the Third IAA Symposium on Searching for Life Signature, held in St-Petersburg in 2011. Stephane Dumas, Alexander Panov, eds. 2015.

Stephen Webb. If the Universe is Teeming with Aliens... Where is everybody? Seventy-Five Solutions to the Fermi Paradox and the Problem of Extraterrestrial Life. Springer, 2015.

Douglas A. Vakoch. Archaeology, Anthropology and Interstellar. 2014.



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